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(54) **TOUCH PANEL HAVING CONDUCTIVE PARTICLE LAYER**

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G06F 3/044 (2006.01)

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CPC ***G06F 3/041*** (2013.01); ***G06F 3/044*** (2013.01); *G06F 2203/04103* (2013.01)

(58) **Field of Classification Search**
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USPC 345/173–179; 178/18.01–18.09, 178/20.01–20.04
See application file for complete search history.

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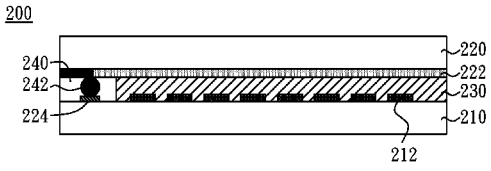
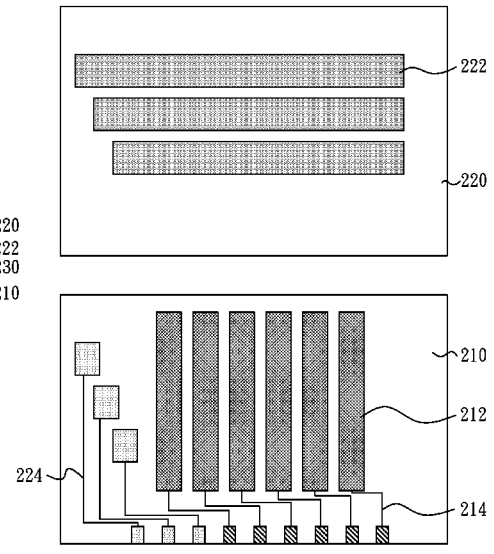
(57) **ABSTRACT**

A touch panel includes first electrodes, second electrodes, first conductive lines, second conductive lines and a conductive particle layer. The first and second electrodes are respectively formed on an upper surface of a first transparent substrate and a bottom surface of a second transparent substrate. The upper surface is adhered to the bottom surface. The first and second conductive lines are formed on a periphery area of the upper surface, and the first conductive lines are electrically connected to the first electrodes. The conducting particle layer, disposed between the first and the second transparent substrate, includes conducting particles, which are electrically connected to the second conductive lines and the second electrodes.

15 Claims, 3 Drawing Sheets





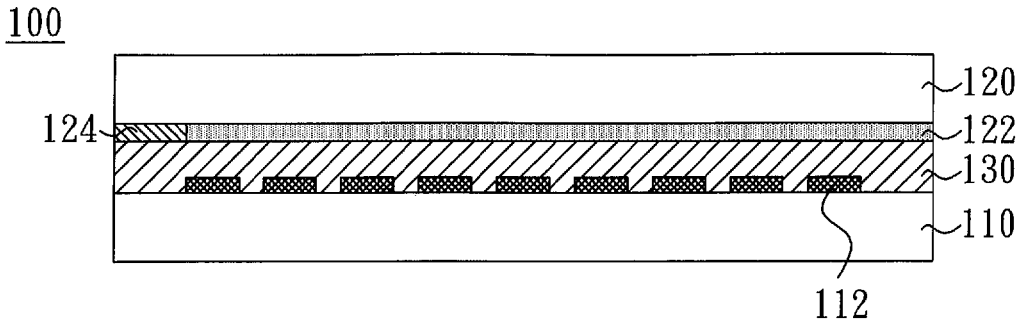


FIG.1A (PRIOR ART)

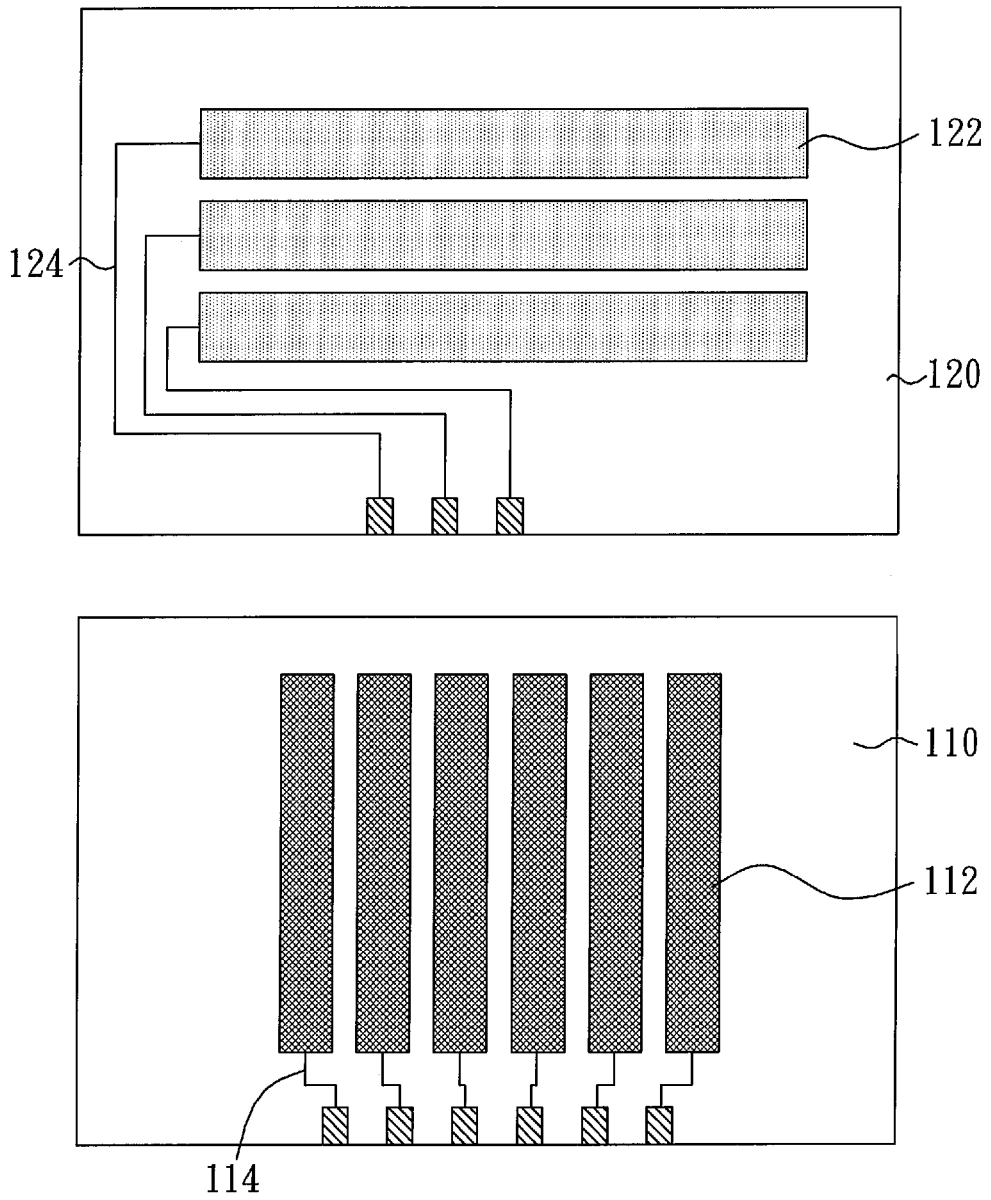


FIG.1B (PRIOR ART)

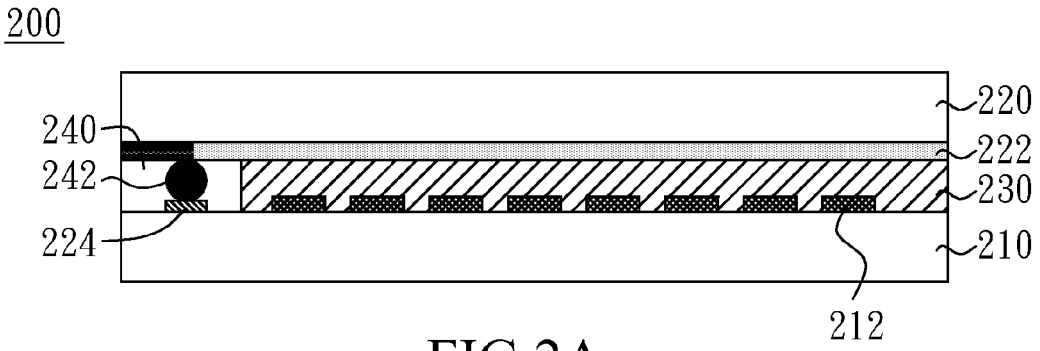


FIG.2A

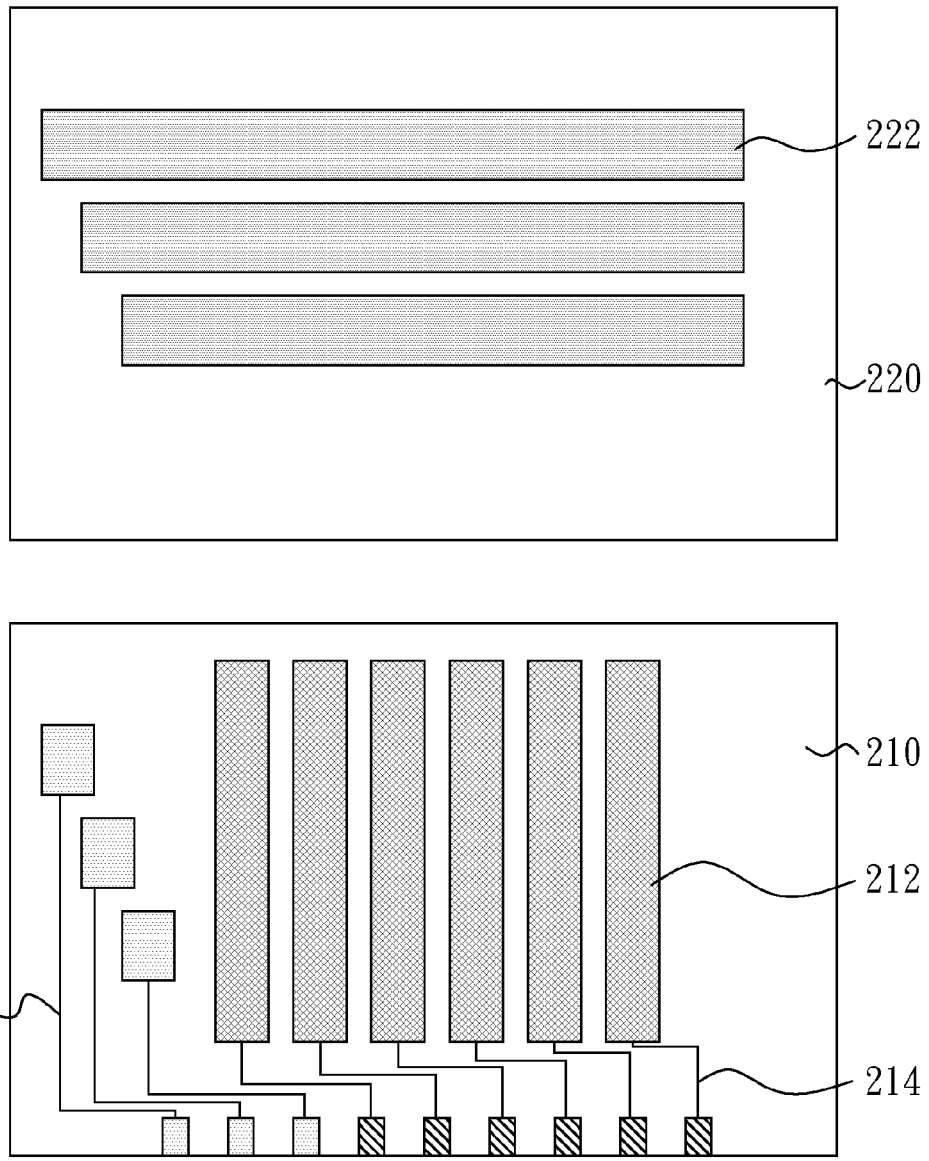


FIG.2B

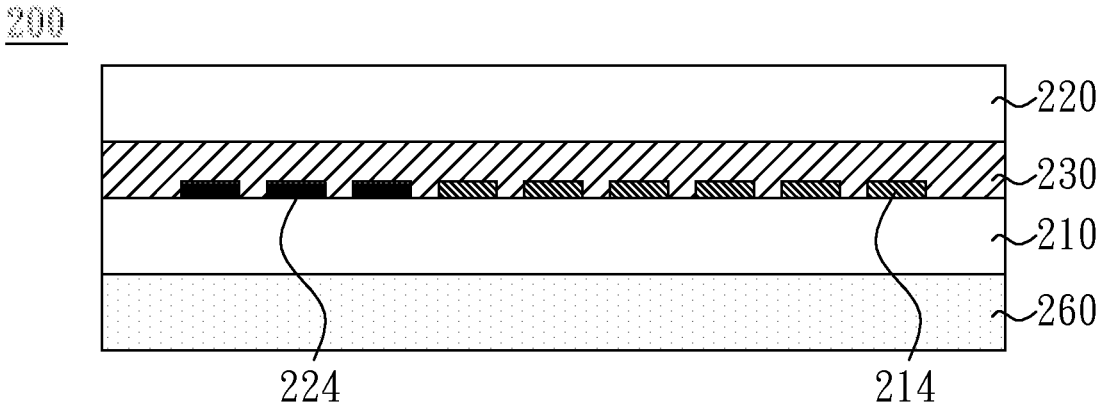


FIG.2C

TOUCH PANEL HAVING CONDUCTIVE PARTICLE LAYER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention generally relates to a touch panel, and more particularly to a touch panel having a double-layer electrode structure.

2. Description of Related Art

Touch screens are input/output devices which adopt sensing technology and display technology, and which have been widely employed in electronic devices such as portable or hand-held electronic devices.

A capacitor-based touch panel is a commonly used touch panel that utilizes a capacitive coupling effect to detect touch position. Specifically, capacitance corresponding to the touch position changes and is thus detected, when a finger touches a surface of the touch panel.

Referring to FIG. **1**A and FIG. **1**B, FIG. **1**A shows a cross-sectional view of a conventional touch panel **100** and FIG. **1**B shows a manufacturing process of the conventional touch panel **100**. As shown in FIG. **1**A and FIG. **1**B, a plurality of first electrodes **112** are disposed on an upper surface of a first substrate **110**, and a plurality of second electrodes **122** are disposed on a bottom surface of a second substrate **120**. Further, the upper surface of the first substrate **110** is adhered to the bottom surface of the second substrate **120** by an optically clear adhesive layer **130**, wherein the first electrodes **112** and the second electrodes **112** could be orthogonal to each other.

In the conventional touch panel **100** mentioned above, a plurality of first conductive lines **114** and a plurality of second conductive lines **124** must be respectively formed on periphery areas of the upper surface of the first substrate **110** and the bottom surface of the second substrate **120** by screen printing process or yellow light manufacturing process, such that the first conductive lines **114** and the second conductive lines **124** are electrically connected to the first electrodes **112** and the second electrodes **122** respectively, in order to transmit sensing signals of the touch position. However, the design and manufacturing process of the conductive lines in the conventional touch panel are complicated, often resulting in high manufacturing costs and low productivity.

A need has thus arisen to propose a novel touch panel to overcome deficiencies of the conventional touch panels.

SUMMARY OF THE INVENTION

In view of the foregoing, it is an object of the embodiment of the present invention to provide a touch panel with a configuration design of the conductive lines to simplify process, reduce manufacturing cost and increase productivity.

According to one embodiment, a touch panel includes a plurality of first electrodes, a plurality of second electrodes, a plurality of first conductive lines, a plurality of second conductive lines and a conductive particle layer. The first electrodes are formed on an upper surface of a first transparent substrate. The second electrodes are formed on a bottom surface of a second transparent substrate. Further, the upper surface of the transparent substrate is adhered to the bottom surface of the second transparent substrate, and the first electrodes are insulated to the second electrodes. The first conductive lines and the second conductive lines are all formed on a periphery area of the upper surface of the first transparent substrate, wherein the first conductive lines are electrically connected to the first electrodes. The conductive particle layer is disposed between the first transparent substrate and the second transparent substrate, and the conductive particle layer has a plurality of conductive particles, configured to be electrically connected to the second conductive lines and the second electrodes.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1**A shows a cross-sectional view of a conventional touch panel;

FIG. **1**B shows a manufacturing view of the conventional touch panel;

FIG. **2**A shows a cross-sectional view of a touch panel according to an embodiment of the present invention;

FIG. **2**B shows a manufacturing view of the touch panel in FIG. **2**A; and

FIG. **2**C shows a top view of a touch panel according to another embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. **2**A and FIG. **2**B, FIG. **2**A shows a cross-sectional view of a touch panel according to an embodiment of the present invention, and FIG. **2**B shows a manufacturing view of the touch panel in FIG. **2**A.

The touch panel **200** in this embodiment includes a plurality of first electrodes **212**, a plurality of second electrodes **222**, a plurality of first conductive lines **214**, a plurality of second conductive lines **224** and a conductive particle layer **240**. The first electrodes **212** are formed on an upper surface of a first transparent substrate **210**, and the first electrodes **212** are disposed in parallel in a first direction. The second electrodes **222** are formed on a bottom surface of a second transparent substrate **220**, and the second electrodes **222** are disposed in parallel in a second direction. The first direction and the second direction are substantially orthogonal to each other. The upper surface of the first transparent substrate **210** is adhered to the bottom surface of the second transparent substrate **220**, and the first electrodes **212** are insulated to the second electrodes **222**. In one embodiment, the touch panel **200** further includes an optically clear adhesive layer **230**, which is disposed between the first transparent substrate **210** and the second transparent substrate **220**. Specifically, an upper surface and a bottom surface of the optically clear adhesive layer **230** are respectively adhered to the first electrodes **212** and the second electrodes **222**.

The first transparent substrate **210** and the second transparent substrate **220** may include insulating material such as glass, Polycarbonate (PC), Polyethylene terephthalate (PET), Polyethylen (PE), Poly vinyl chloride (PVC), Poly propylene (PP), Poly styrene (PS), Polymethyl methacrylate (PMMA) or Cyclic olefin copolymer (COC).

As shown in FIG. **2**A/**2**B, the first conductive lines **214** are formed on a periphery area of the upper surface of the first transparent substrate **210**, wherein an end of each first conductive line **214** is electrically connected to an end of the corresponding first electrode **212**. The second conductive lines **224** are also formed on the periphery area of the upper surface of the first transparent substrate **210**. Making use of the layout and configuration of the conductive lines mentioned above, the first conductive lines **214** and the second conductive lines **224** can simultaneously be formed on the first transparent substrate **210** by screen printing process or yellow light manufacturing process, so as to simplify manufacturing process of touch panel **200**.

Moreover, the conductive particle layer **240** is disposed between the first transparent substrate **210** and the second

transparent substrate **220**. The conductive particle layer **240** has a plurality of conductive particles **242**. Each conductive particle **242** is configured to be electrically connected to both of an end of the second conductive line **224** and an end of the corresponding second electrode **222**. Further, a diameter of the conductive particle **242** is equal to or greater than a gap between the second electrode **222** and the second conductive line **224**, such that the second electrodes **222** may be substantially electrically connected to the conductive particles **242** without user's pressing action, and the sensing signals of touch position detected by the second electrodes **222** can be transmitted by the conductive particles **242** and the second conductive lines **224** for signal processing. In this embodiment, the conductive particles **242** may be metal particles, such as gold, silver, carbon, zinc, indium tin oxide (ITO) particles or a combination thereof.

In another embodiment, the conductive particle layer **240** may further include a frame sealing adhesive or an optically clear adhesive, and the conductive particles **242** are doped in the frame sealing adhesive or the optically clear adhesive. Therefore, after the second conductive lines **224** are formed on the first transparent substrate **210** by screen printing process or yellow light manufacturing process, an end of each second conductive line **224** may be electrically connected to at least one conductive particle **242** by adhering the frame sealing adhesive or the optically clear adhesive, which contains the conductive particles **242**, to the second conductive lines **224**.

In another embodiment, the conductive particle layer **240** may be a conductive tape, and the conductive particles **242** are uniformly distributed in the conductive tape. Thus, after second conductive lines **224** are formed on the first transparent substrate **210**, an end of each second conductive line **224** may be electrically connected to at least one conductive particle **242** by adhering the conductive tape to the second conductive lines **224**. Consequently, after the first transparent substrate **210** and the second transparent substrate are adhered to each other, the first electrodes **212** can transmit sensing signals to the first conductive lines **224** disposed on the first transparent substrate **210** by the conductive particles **242**.

Furthermore, the first electrodes **212** and the second electrodes **222** mentioned above may include a conductive material such as indium tin oxide (ITO), grapheme, Al-doped ZnO (AZO), zinc oxide (ZnO), antimony tin oxide (ATO), Ga Doped ZnO (GZO), F Doped SnO2 (FTO) or a combination thereof.

In another embodiment, the first electrodes **212** and the second electrodes **222** may include a light-transmissive structure made of a non-transparent material. The non-transparent material may include metal nanowires (e.g., silver nanowires or copper nanowires) or metal nanonets (e.g., silver nanonets or copper nanonets). The metal nanowires or nanonets have a diameter in a nanometer order (i.e., a few nanometers to hundreds nanometers), and may be fixed via a plastic material (e.g., resin).

Due to fineness of the metal nanowires/nanonets unobservable to human eyes, the first electrodes **212** and the second electrode **222** made of the metal nanowires/nanonets thus have high light-transmittance and reduce the overall thickness of the touch panel **200**. The metal nanowires/nanonets are interleaved with each other and flatly distributed, therefore each of the first electrode **212** and the second electrode **222** made of the metal nanowires/nanonets therefore has an isotropic conductivity, which is substantially invariant with respect to direction.

According to another aspect of this embodiment the first electrodes **212** and the second electrodes **222** may also include a photosensitive material (e.g., acrylic), through which the first electrodes **212** and the second electrodes **222** with a required pattern may be formed via an exposure development process.

Referring to FIG. **2**C, FIG. **2**C shows a cross-section view of a touch panel **200** according to another embodiment of the present invention. As shown in FIG. **2**C, the first conductive lines **214** and another end of each second conductive line **224** are all disposed on the same side of the touch panel **200**, so that a flexible printed circuit (FCP) bonding process may proceed accordingly, and the sensing signal which is detected by the touch panel **200** may be transmitted to the FCP through the first conductive lines **214** and the second conductive lines **224** for signal processing.

Although the transparent substrate in FIG. **2**C is illustrated with two-dimensional profile, however the present invention is not limited thereto. The transparent substrate of present invention may have a two-dimensional or three-dimensional profile, which may be applied to a two-dimensional or a three-dimensional touch display respectively. In another embodiment, the transparent substrate may also include flexible material or rigid material, and the surface material of the transparent substrate may be processed to have anti-wear, anti-scratch, anti-reflection, anti-glare and anti-fingerprint features.

Moreover, the touch panel **200** may further include a protective film **260**, which is disposed on a bottom surface of the first transparent substrate **210**, for covering the first transparent substrate **210** and providing a protection.

Although specific embodiments have been illustrated and described, it will be appreciated by those skilled in the art that various modifications may be made without departing from the scope of the present invention, which is intended to be limited solely by the appended claims.

What is claimed is:

1. A touch panel, comprising:

a plurality of first electrodes formed on an upper surface of a first transparent substrate;

a plurality of second electrodes formed on a bottom surface of a second transparent substrate, wherein the upper surface of the first transparent substrate is adhered to the bottom surface of the second transparent substrate, and the first electrodes are insulated to the second electrodes;

a plurality of first conductive lines formed on a periphery area of the upper surface of the first transparent substrate, wherein an end of each first conductive line is electrically connected to one of the first electrodes;

a plurality of second conductive lines formed on the periphery area of the upper surface of the first transparent substrate; and

a conductive particle layer disposed between the first transparent substrate and the second transparent substrate, wherein the conductive particle layer has a plurality of conductive particles, configured to be electrically connected to the second conductive lines and the second electrodes.

2. The touch panel of claim **1**, wherein each of the first transparent substrate and the second transparent substrate comprises glass, Polycarbonate (PC), Polyethylene terephthalate (PET), Polyethylen (PE), Poly vinyl chloride (PVC), Poly propylene (PP), Poly styrene (PS), Polymethyl methacrylate (PMMA) or Cyclic olefin copolymer (COC).

3. The touch panel of claim **1**, further comprising an optically clear adhesive layer disposed between the first transparent substrate and the second transparent substrate, wherein the optically clear adhesive layer is adhered to the first electrodes and the second electrodes.

4. The touch panel of claim 1, wherein a diameter of each conductive particle is equal to or greater than a gap between the second electrode and second conductive line.

5. The touch panel of claim 1, wherein the conductive particles are gold, silver, carbon, zinc, indium tin oxide (ITO) particles or a combination thereof.

6. The touch panel of claim 1, wherein the conductive particle layer further includes a frame sealing adhesive or an optically clear adhesive.

7. The touch panel of claim 1, wherein the conductive particle layer is a conductive tape.

8. The touch panel of claim 1, wherein each of the first electrodes and the second electrodes includes a conductive material, and the conductive material comprises indium tin oxide (ITO), grapheme, Al-doped ZnO (AZO), zinc oxide (ZnO), antimony tin oxide (ATO), Ga Doped ZnO (GZO), F Doped SnO2 (FTO) or a combination thereof.

9. The touch panel of claim 1, wherein each of first electrodes and the second electrodes includes a light-transmissive structure made of a non-transparent material.

10. The touch panel of claim 9, wherein the non-transparent material comprises metal nanowires or metal nanonets.

11. The touch panel of claim 10, wherein the metal wire or the metal nanonet has a diameter of some nanometers to hundreds of nanometers.

12. The touch panel of claim 10, wherein the metal wires or the metal nanonets are flatly distributed.

13. The touch panel of claim 10, wherein the first electrodes and the second electrodes further comprise plastic material, for fixing the non-transparent conductive material in the first electrodes and the second electrodes.

14. The touch panel of claim 1, wherein the first electrodes and the second electrodes further comprise photoresistive material.

15. The touch panel of claim 1, further comprising a protective film disposed on a bottom surface of the first transparent substrate.

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